 

*Architects, Biomedical Engineers, Astronomers, Veterinary Technicians, Statisticians, Computer Programmer, these are just a few of the many exciting occupations that use scientific notation! In this unit we will uncover the meaning behind this new language. Beginning with a study of the key component to understand scientific notation – exponents, and ending with an exploratory look at its real word applications. Google Earth, collaborative challenges, and iMovie will be just some of the cool tools we will utilize in order to guide us on our mathematical journey.*

*RSU#9*

*Kiera J. Timme*

*Scientific notation*

*Mathematics*

*Grade 8*

*Integer Exponents & Scientific Notation*

*• exponents can be used to express numerical values in different, but equivalent, ways*

*• scientific notation is used/can be used to represent large and small quantities.*

*• scientific notation has real-world applications*

*• demonstrate how to convert numbers expressed as decimals to scientific notation and vice-versa.  
• represent large and small quantities using scientific notation.  
• solve problems involving scientific notation.  
• analyze data that contains scientific notation.  
• relate real numbers to their exponential form  
• recognize when, and how, to use the properties of exponents.*

*• Definitions: Exponents, scientific notation, powers, standard notation,  
decimals, integers  
• Critical Details: Properties of exponents, place value, negative, exponents,  
scientific notation operations, magnitude, measurements and units.  
• Applications: Real world use of scientific notation, problem solving strategies, data analysis, finding rates.*

*• How can we use exponents to express numerical values in different, but equivalent, ways?*

*• How and why is scientific notation used to represent very large or very small values?*

*• How is scientific notation applied in the real world?*

*3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3 x 10^8 and the population of the world as 7 x 10^9, and determine that the world population is more than 20 times larger.*

*SDSD  
4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.*

*1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27*

***Common Core State Standards******Content Area:*** *Mathematics****Grade Level:*** *Grade 8****Domain:*** *Expressions and Equations****Cluster:*** *Work with radicals and*

*integer exponents.****Standard:*** *1, 3, 4*

***Goal:*** *To create a multimedia fact sheet about state specific endangered species for the U.S Fish & Wildlife Services.****Role:*** *You are a team of Environmental Researchers with a passion for wildlife conservation.****Audience:*** *Department Heads of the Endangered Species division of the U.S Fish & Wildlife Services.****Situation:*** *Raising public awareness of local endangered species.****Product/Presentation:*** *You will use Prezi to create an informative and engaging multimedia fact sheet featuring at least 5 endangered species from the chosen state. All numerical data must be expressed in both standard and scientific notation.****Standards (Criteria from both rubrics - product and presentation):***Product: *Content = 25%, Research & Statistical Data = 25%, Sources = 15%, Mathematical Accuracy = 15%, Attractiveness = 10%, and Effectiveness = 10 %*Presentation: *Preparedness = 25%, Enthusiasm = 25%, Comprehension = 20%, Collaboration with Peers = 15%, Evaluates Peers = 10%, and Time Limit = 5%*

*• Pre-assessment: prerequisite review, review student records, student survey/self-assessment  
• Checking for Understanding: Think, Pair & Share, Onion ring, Clickers, Give one-Get one, Journaling, Note comparison  
• Timely Feedback:  
Self - Students use rubric to self-assess  
Peer - In their role as the audience, students will have feedback cards to score classmates  
Teachers - Copies of the completed presentation and product rubrics will be provided to the students in a timely manner*

*• Glogster: Create a digital poster showing your fellow 8th graders how to convert numbers from standard notation to scientific notations and vice versa  
• Blog: Use the links from the class wiki to find data about very large and very small objects, animals, buildings, etc..Then write a blog posting which includes an image and the measurements of your chosen data in scientific and standard notation.  
• Show Me App: Design an 8 question scientific notation operations quiz for you fellow classmates. Then, using the "Show Me" app, create a step by step answer key for each question.  
• Google Earth & Prezi: Use Google Earth to find population statistics and other information about two different countries. Use this information to create a Prezzi presentation that compares and contrasts the two countries data. This comparison must include an analysis of the two countries. For example: how many times bigger the population (or other figure) of one country is than the other?  
• Wix: Create a website using wix.com that demonstrates how real numbers can be expressed using exponents. The website you create should act as a study guide for anyone who wanted to learn about exponents.  
• iMovie: Create a news report as if the "Properties of Exponents" have just been discovered and you have to explain them to the world.*

*Oral Presentation*

*The Endangered Species division of U.S Fish and Wildlife Services is looking to commission a team of Environmental Researchers to create multimedia fact-sheets that raises public awareness about endangered species in their states. In order to decide which team of researchers they are going to use, the U.S Fish and Wildlife Services wants to see an example of a multimedia fact-sheet for a particular states' endangered species. The fact-sheet must include at least five state endangered species (one bird, one mammal, one plant life, one insect, one aquatic animal). In addition, the fact-sheet must provide the following: 1. Size of the animal/plant, 2. Habitat location and range (size), 3. Image of the Animal, 4. Population size, 5. Rate of population decline/growth over the last 5 or 10 years, 6. An interesting/fun fact, 7. Distance of Migration (if applicable), 8. At least two audio/video components. All measurements must have appropriate units and be given in both standard and scientific notation. Federal and State Endangered Species division officials will decide the winning team. Winners will not only be awarded this valuable commission, they will also been flown out to Washington DC for the National Wildlife Federations annual gala where they will present the final product.*

* *critical thinking*
* *problem solving skills*
* *exponent notation*
* *scientific notation*
* *data analysis*
* *Scientific Notation & Integer Exponents*

***Common Core State Standards Standard:*** *1, 3, 4****Content Area:*** *Mathematics****Grade Level:*** *Grade 8****Domain:*** *Expressions and Equations****Cluster:*** *Work with radicals and integer exponents.*

*• scientific notation is used/can be used to represent large and small quantities.*

*• scientific notation has real-world applications*

*• Preparedness - 25%  
• Enthusiasm - 25%  
• Comprehension - 20%  
• Collaboration with Peers - 15%  
• Evaluates Peers - 10%  
• Time Limit - 5%*

*• Content - 25%  
• Research & Statistical Data - 25%  
• Sources - 15%  
• Mathematical Accuracy - 15%  
• Attractiveness - 10%  
• Effectiveness - 10 %*

*Prezi (Digital Presentation)*

***By what criteria will student products/performances be evaluated?***

***(W)****1.1 Students will understand that exponents can be used to express numerical values in different, but equivalent, ways* ***(Where)****, Most real world experiences do not follow a straight path. Understanding the way exponents work represents a building block in our understanding of the world* ***(Why),*** *Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27* ***(What)******(H)*** *1.2 Exponent Song: "Super Base" parody -* [*http://www.youtube.com/watch?v=QIZTruxt2rQ*](http://www.youtube.com/watch?v=QIZTruxt2rQ)***(Hook)******(E)*** *1.3 Students will know: positive and negative exponents, integers, properties of exponents (****Equip)****,Students will be separated into 4 groups (Numbered Heads) Each group will create a Flowchart to demonstrate the steps for solving problems using one of the four the properties of exponents* ***(Explore)****, Through the iMovie activity students will be able to recognize and describe the properties of exponents* ***(Experience)******(R)****1.4 Students will use their math journals to summarize their understanding of each of the four exponent properties* ***(Rethink)*** *their journals will be used as a form of self-assessment, they will compare their summaries with their peers, and then reflect on what they have written and make any necessary revisions. Journals will be collected by me and written feedback will be provided* ***(Rethink/Revise)*** *They will use their summaries and a checklist to help create their iMovies. I will review their iMovies electronically and then use the same checklist to provide feedback so they can make adjustments* ***(Revise/Refine)******(E)*** *1.5 Formative Assessment -* ***Pre-assessment:*** *prerequisite review, review student records, student survey/self-assessment* ***,******Checking for Understanding:*** *Journaling,* ***Evaluate****: Teacher, Peer, Self****(T)****1.6* ***Tailors (MI) -******Verbal:*** *Students will writing a journal summary about the properties of exponents. They will also create an iMovie in which they must verbalize the properties of exponents.****Logic:*** *Students will develop their logical thinking skills as they create their properties of exponent flowchart.****Visual:*** *The hook involves visual example of exponent properties in actions. Students will create a flowchart to visualize the steps to solve using the properties of exponents. The iMovie will also include visuals about the properties of exponents.****Kinesthetic:*** *Student will be given post-it notes to write their steps on, and then use these to put the steps in sequence and then transpose this to their flowcharts.****Musical:*** *The "Hook" is a song all about the properties of exponents. During the iMovie "Properties of Exponents News Broadcast" students will be give autonomy over how their news station presents the information, this could include a musical rendition like the hook.****Interpersonal:*** *Students will work in groups to create their flowcharts and iMovie. They will also use peer feedback on both activities to reflect on the learning.****Intrapersonal:*** *Students will work independently when they initially write their exponent properties summary. They will also self-evaluate their iMovies.****Naturalistic:*** *I will create a student sample for the iMovie using a naturalist perspective.****(O)****1.7 Students will be able to recognize when, and how, to use the properties of exponents,* ***(Self-Knowledge)******Product:*** *iMovie,* ***Number of Days:*** *3* ***(Organize)***

***(W)*** *2.1 Students will understand that exponents can be used to express numerical values in different, but equivalent, ways* ***(Where)****, Most real world experiences do not follow a straight path, they are often exponential in nature. Understanding the way exponents work represents an important building block in our understanding of the world* ***(Why),*** *Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27* ***(What)******(H)*** *2.2 Nothing we do in math cannot be undone...lets uncover the hidden exponents in some numbers. Video Intro:* [*https://www.youtube.com/watch?v=hP7K-ZiEPZw*](https://www.youtube.com/watch?v=hP7K-ZiEPZw)***(Hook)******(E)*** *2.3 Students will know: positive and negative exponents, integers, properties of exponents (****Equip),*** *each student is given an number to rewrite in exponential form. Students will use the step-by-step organizer to demonstrate each step they made. Then, using the mix-pair freeze method, student will explain their solutions to their partners* ***(Explore),*** *Student will create guide, using wix.com, describing how real numbers relate to their exponential form* ***(Experience)******(R)*** *2.4 Using the Think, Pair, Share model, students will create, compare with a partners and the class (posting on class wiki), their step-by-step organizers* ***(Rethink),*** *students will then use a checklist to make sure they have all the necessary steps* ***(Rethink/Revise)*** *I will review both their step-by-step organizers and provide feedback, then use the checklist to provide feedback about the wix.com product so they can make adjustments* ***(Revise/Refine)******(E)*** *2.5 Formative Assessment -* ***Checking for Understanding****: Think, Pair, Share,* ***Evaluate****: Teacher, Peer, Self****(T)****2.6* ***Tailors****:****Verbal:*** *Students will create a wix.com study guide describing how to transform real numbers into their exponential form.****Logic:*** *Students will demonstrate what thinking processes they used while rewriting the real numbers in exponential form.****Visual:*** *Student will create a step-by-step solutions organizer detailing the steps they used to solve their assigned problems.****Kinesthetic:*** *When I explain how to work with negative exponents I will have the students act out the process of bringing the number down - "Negative exponents are not happy where they are, they want to move, and then they'll be happy (positive)"****Interpersonal:*** *Students will get to work together in the "Think, Pair, Share" to explain how they solved their exponent problems.****Intrapersonal:*** *During the "Think, Pair, Share" activity students will be given ample time to think independently about their assigned problem.****(O)*** *2.7 Students will be able to relate real numbers to their exponential form,* ***(Empathy) Product****: wix.com,* ***Number of Days****: 3* ***(Organize)***

***(W)*** *3.1 Students will understand that scientific notation is used/can be used to represent large and small quantities* ***(Where)****, Did you know that Mathematicians and Scientists were lazy? Well... this is half true. Some numbers are so long and have so many values, that writing the whole thing out just isn't an efficient way to express them. So scientific notation was invented as a way to deal with this problem, and is used in many real world occupations on a daily basis* ***(Why)****, Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3 x 10^8 and the population of the world as 7 x 10^9, and determine that the world population is more than 20 times larger* ***(What)******(H)*** *3.2 Take out calculators and type 1000000 x 360000 - Ask students what they think this means* ***(Hook)******(E)*** *3.3 Students will know: place value, powers, scientific notation, standard notation, real world applications* ***(Equip)****,students will fill the ticktacktoe organizer with conversions of very large and very small numbers, found using the links on the class wiki, into scientific notation and vice versa, but they must purposely make two mistake. Then, students will split into teams of 3 where they must each "find the fib"in their teammates work* ***(Explore)*** *Once the conversion are correct, they will then write a blog about their research with the data represented in scientific notation* ***(Experience)******(R)*** *3.4 During the "find the fib" activity student will be checking their own, and their team mates conversions* ***(Rethink),*** *a class discussion will then be held, using the "onion ring" activity, to discuss any data that the students would like to check is correctly converted* ***(Rethink/Revise),*** *the blogs will then be viewed and students will be given feedback by the teacher in order to make any adjustments* ***(Revise/Refine)******(E)*** *3.5 Formative Assessment -* ***Checking for Understanding****: Onion Ring,* ***Evaluate****: Teacher, Self****(T)****3.6* ***Tailors****:****Verbal:*** *Students will write a blog about their research findings****Logic:*** *Students will think critically to purposely create incorrect scientific notation conversions designed to "out wit" their classmates****Visual:*** *Students will make use tictacktoe organizer to display their conversions. Research will be conducted through internet site that include images.****Musical:*** *Links to resources on the class wiki will include musical instruments of various sizes to use for data****Interpersonal:*** *Students will work in groups to find their classmates "fibs". This will involve a lot of group discussion****Intrapersonal:*** *Students will be given a choice of links (on the class wiki) to explore based on teacher knowledge of student interests****Naturalistic:*** *Links to resources will include sites with data on animals (large and small), insects, sea life, and plant life****(O)*** *3.7 Students will be able to represent large and small quantities using scientific notation,* ***(Interpret) Product****: Blog,* ***Number of Days****: 2* ***(Organize)***

***(W)*** *4.1 Students will understand that scientific notation is used/can be used to represent large and small quantities* ***(Where)****, Not only does scientific notation allows us to express numbers more efficiently, it also allow us to perform operations with these very large and very small numbers more effectively* ***(Why),*** *Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is smaller than the other. For example, estimate the population of the United States as 3 x 10^8 and the population of the world as 7 x 10^9, and determine that the world population is more than 20 times larger* ***(What)******(H)*** *4.2 Ask students? "Do you like shortcuts? Yes! Well good news! Our exponent properties are just the tools we need to perform scientific notation operations!****(E)*** *4.3 Students will know: scientific notation operations, problem solving strategies* ***(Equip),*** *students will be assigned a partner, each partner will be assigned the inverse operation to a scientific notation problem they must solve. They must use the inverted triangle chart to display each step they used when solving. One chart will be made per problem type. Then the partners will meet up and try to attempt a new, but similar problem, using their partners inverted triangle chart as a guide* ***(Explore)*** *Students will, using the inverted triangle as a guide, create a detailed answer key, using the Show Me app, to show fellow students how to solve the problems in the quizzes they create* ***(Experience)******(R)*** *4.4 Problems from the student generated quizzes will be taken, informally, by the class using clickers* ***(Rethink)*** *students will be shown a student sample, and provided with checklist, to self-assess their "show me" answer key* ***(Rethink/Revise)*** *I will then meet one-on-one with each student to view their answer key and, using the checklist, be provide specific feedback so students can make adjustments* ***(Revise/ Refine)******(E)*** *4.5 Formative Assessment -* ***Checking for Understanding****: Clickers,* ***Evaluate****: Teacher, Peer, Self****(T)****4.6* ***Tailors****:****Verbal:*** *Students will create an answer key using the "show me" app which allows them to verbally communicate each step in the process.****Logic:*** *Students will be connecting their knowledge of exponents and applying them during the inverted triangle activity and when creating their answer key.****Visual:*** *Students will be using an inverted triangle organizational chart to clearly define each step when performing operations using scientific notation. The "show me" app acts like an interactive white board allowing students to use a variety of colors, shapes, etc... to create their answer key.****Kinesthetic:*** *When students use the "show me" app, they will use their fingers as the writing/drawing tool.****Musical:*** *Students could choose to have a musical accompaniment to their "show me" answer key. The oral aspect of their answer key could be done through song or rap.****Interpersonal:*** *Students will share their solutions steps with their partner, and discuss how and why they solved the problems the way that they did.****Intrapersonal:*** *Students will work independently on their problems before sharing. They will also be required to create their quizzes and answers keys on their own****(O)*** *4.7 Students will be able to solve problems involving scientific notation,* ***(Apply) Product****: Show Me App,* ***Number of Days****: 3* ***(Organize)***

***(W)*** *5.1 Students will understand that scientific notation has real-world applications* ***(Where)****, certain occupations depend on scientific notation in order to be effective at their job. Astronomers calculate the distance between planets are stars, some of which wouldn't even fit on a calculator screen, or a A4 page* ***(Why),*** *perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g.,use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology* ***(What)******(H)*** *5.2 STAR TREK -* [*http://www.youtube.com/watch?v=DOryEhRTP7A*](http://www.youtube.com/watch?v=DOryEhRTP7A)***(Hook)******(E)*** *5.3 Students will know: magnitude, measurements and units* ***(Equip)*** *with a partner, students will use the ladder organizer to track the step to converting decimals to scientific notation and vice versa, using the "YouGo-IGo" method. This involves alternating between each students, with each only doing one line of the problem. They cannot move on to the next step unless they both agree with the last move. Once finished students will write, in words, what they did next to each step* ***(Explore)*** *Students will use their ladder organizer to help them, and their partner, create a Glogster that demonstrates how to convert numbers expressed as decimals to scientific notation, and vice versa* ***(Experience)******(R)*** *5.4 Each pair will meet up with two other pairings to compare notes* ***(Rethink)*** *students will use a checklist to assess their Glogster creations* ***(Rethink/Revise)*** *Students will send their Glogsters electronically and I will provide feedback, notes and checklist, so that they can make the recommended adjustments* ***(Revise/Refine)******(E)*** *5.5 Formative Assessment -* ***Checking for Understanding****: Compare Notes,* ***Evaluate****: Teacher, Student, Peer****(T)*** *5.6* ***Tailors****:****Verbal:*** *Students will include written explanations for each step they made on their ladder when converting decimals into scientific notation.****Logic:*** *Students will connect their prior knowledge of place value to the decimal conversions activity. Students will consider the relationship between powers of ten and the previous activities involving exponents.****Visual:*** *Students will use the Ladder graphic organizer to highlights the steps necessary to convert decimals to scientific notation. The students will also use a variety of graphics and videos to create their Glogster products.****Kinesthetic:*** *Students will act out the process of "bopping" the decimal place when converting decimals into scientific notation****Musical:*** *The Glogster activity will be students the options to include music and videos in their product.****Interpersonal:*** *During the "YouGo-IGo" activity, students will have to communicate with their partners before moving on to the next step. Students will also work with a partner when creating their Glogster.****Naturalistic:*** *The "hook" features images of space as a way to connect the content to the real world.****(O)*** *5.7 Students will be able to demonstrate how to convert numbers expressed as decimals to scientific notation, and vice versa,* ***(Explain) Product****: Glogster,* ***Number of Days****: 2* ***(Organize)***

***(W)****6.1 Students will understand* *that scientific notation has real-world applications (Where),certain occupations depend on scientific notation in order to be effective at their job. Astronomers calculate the* *distance between planets are stars, some of which wouldn't even fit on a calculator screen, or a A4 page* ***(Why)****​, perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g.,use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology* ***(What)******(H)****6.2 Scale of the Universe -* [*http://htwins.net/scale2/*](http://htwins.net/scale2/)***(Hook)******(E)*** *6.3 Students will know: real world applications, problem solving skills, data analysis* ***(Equip),*** *students will use the ISP Chart to organize the data they gather from Google Earth about their randomly assigned countries. Students will then participate in the "inside/outside" activity an share the information they found* ***(Explore)*** *Student will then pair up with a partner with a different country. Together they will analyze the data, ensuring all information is presented in both standard and scientific notation, includes appropriate measurement and units, and correctly cites their sources. This will then be turned into a Prezi presentation that compares and contrasts the two countries* ***(Experience)******(R)*** *6.4 While students are researching countries, students will use the Give one, Get One activity to share ideas* ***(Rethink)****, students will be given a checklist for their Prezi detailing the information on their country they must find and what to do with it when comparing and contrasting so they can self- assess* ***(Rethink/Revise)****, Prezis in-progress will be uploaded onto the class wiki so I can provide feedback, using the checklist, so that students can make adjustments* ***(Revise/Refine)******(E)*** *6.5 Formative Assessment -* ***Checking for Understanding****: Give one, Get One,* ***Evaluate****: Teacher, Self****(T)****6.6* ***Tailors****:****Verbal:*** *When creating their Prezis students must provide written information about the country they are researching, and carefully cite any sources used.****Logic:*** *Students will be using their knowledge of scientific notation and relating to the real world.****Visual:*** *Students will be given the opportunity to explore the "scale of the universe" hook. This in an interactive model with tons of visuals with the size of each object expressed in scientific notation.****Kinesthetic:*** *The "Give One, Get One" activity provide students with the opportunity to move around the class and ask questions with purpose.****Interpersonal:*** *Students will work in teams to compare and contrast their countries. After which they must work to create their Prezi.****Intrapersonal:*** *Students will initially work independently to find the required information about their assigned****Naturalistic:*** *Students will be given the opportunity to explore the "scale of the universe" hook. This model includes many animals and plant life with their sizes in scientific notation. For the Prezi students must find data about the countries national animal, flower, or other natural treasure.****(O)*** *6.7 Students will be able to analyze data that contains scientific notation,* ***(Perspective) Product****: Google Earth & Prezi,* ***Number of Days****: 3* ***(Organize)***

* 1. *(W) Scientific Notation (RW)*
  2. *(H) Universe*
  3. *(E) ISP Chart*
  4. *(R) Self, Teacher*
  5. *(E) Checklist*

*6.7 (O) Perspective, 3 days*

*5.1 (W) Scientific Notation (RW)*

* 1. *(H) Video*
  2. *(E) Ladder*
  3. *(R) Checklist*

*5.5 (E) Self, Peer, Teacher*

*5.7 (O) Explain, 2 days*

* 1. *(W) Scientific Notation*
  2. *(H) Shortcuts*
  3. *(E) Inverted Triangle*

*4.4 (R) Checklist*

*4.5 (E) Self, Peer, Teacher*

*4.7 O) Apply, 3 days*

* 1. *(W) Scientific Notation*

*3.2 (H) Calculator*

* 1. *(E) TickTackToe*
  2. *(R) Teacher Feedback*

*3.5 (E) Self, Teacher*

*3.7 (O) Interpret, 2 days*

*2.1 (W) Exponents*

*2.2(H) Video/Math Detective*

* 1. *(E) Step-by-step*
  2. *(R) Checklist*
  3. *(E) Self, Peer*

*2.7 (O) Empathy, 3 days*

* 1. *(W) Exponents*
  2. *(H) Video*
  3. *(E) Flowchart*
  4. *(R) Checklist*
  5. *(E) Self, Peer Teacher*

*1.7 (O) Self-Knowledge, 3 days*